

## AMENDMENTS TO THE CLAIMS

Please amend the claims of the present application as set forth below in the following claim listing. A status identifier is provided for each claim in a parenthetical expression following each claim number. Changes to the claims are shown by strikethrough (for deleted matter) or underlining (for added matter).

### Claim Listing:

1. (Cancelled).

2. (Currently amended) One or more computer readable media ~~as recited in claim 1,~~ having stored thereon a plurality of instructions that, when executed by one or more processors, causes the one or more processors to perform acts including:

receiving an initial image selection;

generating a plurality of query vectors by extracting, for each query vector, one of a plurality of low-level features from the initial image selection;

selecting a set of potentially relevant images based at least in part on distances between the plurality of query vectors and a plurality of feature vectors corresponding to low-level features of a plurality of images;

receiving feedback regarding the relevance of one or more images of the set of potentially relevant images;

generating a new plurality of query vectors based at least in part on the feedback;

generating a weighting of feature elements based at least in part on the feedback; and

selecting a new set of potentially relevant images based at least in part on both the weighting of feature elements and distances between the new plurality of query vectors and the plurality of feature vectors, wherein the selecting a new set of potentially relevant images comprises using a matrix in determining the distance between one of the new plurality of query vectors and one of the plurality of feature vectors, and further comprising dynamically selecting the matrix based on both a number of images in the set of potentially relevant images for which relevance feedback was input and a number of feature elements in the one feature vector.

3. (Original) One or more computer readable media as recited in claim 2, wherein the dynamically selecting comprises using a diagonal matrix if the number of images in the set of potentially relevant images for which relevance feedback was input is less than the number of feature elements in the one feature vector, and otherwise using a full matrix.

4. (Original) One or more computer readable media as recited in claim 2, wherein the dynamically selecting comprises:

if the number of images in the set of potentially relevant images for which relevance feedback was input is not less than the number of feature elements in the one feature vector, then using one matrix that transforms the query vector and the one feature vector to a higher-level feature space and then using another matrix that assigns a weight to each element of the transformed query vector and the transformed feature vector; and

if the number of images in the set of potentially relevant images is less than the number of feature elements in the one feature vector, then using a matrix that assigns a weight to each element of the query vector and the one feature vector.

5. (Previously presented) One or more computer readable media as recited in claim 2, wherein  $X$  represents an image matrix that is generated by stacking  $N$  feature vectors, each of length  $K$ , corresponding to the set of potentially relevant images for which relevance feedback was received and resulting in an  $(N \times K)$  matrix,  $C$  represents a weighted covariance matrix of  $X$ ,  $\det(C)$  represents the matrix determinant of  $C$ , and the matrix comprises a full matrix ( $W^*$ ) that is generated as follows:

$$W^* = (\det(C))^{\frac{1}{K}} C^{-1}.$$

6. (Previously presented) One or more computer readable media as recited in claim 2, wherein  $w_{kk}$  represents the  $kk^{\text{th}}$  element of matrix  $W$ ,  $x_k$  represents the  $k^{\text{th}}$  feature element,  $\sigma_k$  represents the standard deviation of the sequence of  $x_k$ 's, the matrix comprises a diagonal matrix with each diagonal element ( $w_{kk}$ ) being generated as follows:

$$w_{kk} = \frac{1}{\sigma_k}.$$

7. (Currently amended) One or more computer readable media ~~as recited in claim 1~~ having stored thereon a plurality of instructions that, when executed by one or more processors, causes the one or more processors to perform acts including:

receiving an initial image selection;

generating a plurality of query vectors by extracting, for each query vector, one of a plurality of low-level features from the initial image selection;

selecting a set of potentially relevant images based at least in part on distances between the plurality of query vectors and a plurality of feature vectors corresponding to low-level features of a plurality of images;

receiving feedback regarding the relevance of one or more images of the set of potentially relevant images;

generating a new plurality of query vectors based at least in part on the feedback, wherein  $N$  represents the number of images in the set of potentially relevant images for which relevance feedback has been received,  $\pi_n$  represents the relevance of image  $n$  in the set of images,  $\pi^{\rightarrow T}$  represents a transposition of a vector generated by concatenating the individual  $\pi_n$  values, and  $X$  represents an image matrix that is generated by stacking  $N$  training vectors corresponding to the set of potentially relevant images into a matrix, and wherein each new query vector ( $\vec{q}$ ) of the new plurality of query vectors is generated as follows:

$$\vec{q} = \frac{\pi^{\rightarrow T} X}{\sum_{n=1}^N \pi_n};$$

generating a weighting of feature elements based at least in part on the feedback; and

selecting a new set of potentially relevant images based at least in part on both the weighting of feature elements and distances between the new plurality of query vectors and the plurality of feature vectors.

8. (Previously presented) One or more computer readable media having stored thereon a plurality of instructions that, when executed by one or more processors, causes the one or more processors to perform acts including:

receiving an initial image selection;

generating a plurality of query vectors by extracting, for each query vector, one of a plurality of low-level features from the initial image selection;

selecting a set of potentially relevant images based at least in part on distances between the plurality of query vectors and a plurality of feature vectors corresponding to low-level features of a plurality of images;

receiving feedback regarding the relevance of one or more images of the set of potentially relevant images;

generating a new plurality of query vectors based at least in part on the feedback;

generating a weighting of feature elements based at least in part on the feedback; and

selecting a new set of potentially relevant images based at least in part on both the weighting of feature elements and distances between the new plurality of query vectors and the plurality of feature vectors, wherein  $f_i$  represents a summation, over the images in the set of potentially relevant images, of a product of a relevance of the image and a distance between the query vector and the feature vector, and wherein the selecting a new set of potentially relevant images comprises combining, for each image, a weighted distance between the plurality of query vectors and the plurality of feature vectors, and wherein the weight ( $u_i$ ) for

each of a plurality ( $I$ ) of distances between a query vector and a corresponding feature vector is calculated as:

$$u_i = \sum_{j=1}^I \sqrt{\frac{f_j}{f_i}}.$$

9. (Cancelled).

10. (Currently amended) One or more computer readable media ~~as recited in claim 1~~ having stored thereon a plurality of instructions that, when executed by one or more processors, causes the one or more processors to perform acts including:

receiving an initial image selection;

generating a plurality of query vectors by extracting, for each query vector, one of a plurality of low-level features from the initial image selection, wherein the low-level features include: a color moments feature, a wavelet based texture feature, and a water-fill edge feature;

selecting a set of potentially relevant images based at least in part on distances between the plurality of query vectors and a plurality of feature vectors corresponding to low-level features of a plurality of images;

receiving feedback regarding the relevance of one or more images of the set of potentially relevant images;

generating a new plurality of query vectors based at least in part on the feedback;

generating a weighting of feature elements based at least in part on the feedback; and

selecting a new set of potentially relevant images based at least in part on both the weighting of feature elements and distances between the new plurality of query vectors and the plurality of feature vectors.

11. (Original) A method of selecting between two types of matrixes to be used to weight, based on relevance feedback, a plurality of feature elements for image retrieval, the method comprising:

selecting one of the two types of matrixes based on both a number of previously retrieved relevant images and a length of a feature vector including the plurality of feature elements.

12. (Original) A method as recited in claim 11, wherein the selecting comprises selecting one of the two types of matrixes based on both a number of previously retrieved potentially relevant images which were identified by a user as being relevant, and the length of the feature vector including the plurality of feature elements.

13. (Original) A method as recited in claim 11, wherein the plurality of feature elements are all elements of the same feature.

14. (Original) A method as recited in claim 11, wherein the selecting comprises using a first type of matrix if the number of retrieved relevant images is less than the length of the feature vector, and otherwise using a second type of matrix.

15. (Original) A method as recited in claim 14, wherein the first type of matrix comprises a diagonal matrix and wherein the second type of matrix comprises a full matrix.

16. (Original) A method as recited in claim 11, wherein the selecting comprises using a first type of matrix if the length of the feature vector exceeds the number of retrieved relevant images by at least a threshold amount, and otherwise using a second type of matrix.

17. (Original) A method as recited in claim 16, wherein the first type of matrix comprises a full matrix and the second type of matrix comprises a diagonal matrix.

18. (Original) One or more computer readable media including a computer program that is executable by a processor to perform the method recited in claim 11.

19. (Previously presented) One or more computer readable media having stored thereon a plurality of instructions that, when executed by one or more processors, causes the one or more processors to perform acts including:

comparing, for each of a plurality of images, a plurality of feature elements from a query vector to a plurality of feature elements from a feature vector corresponding to the image;



identifying a number of potentially relevant images based on the comparing;

receiving user feedback regarding relevancy of one or more of the potentially relevant images;

re-comparing, for each of the plurality of images, the plurality of feature elements from the query vector to the plurality of feature elements from the feature vector, including using a matrix to compare the feature elements and dynamically selecting a type of matrix to use based on both the user feedback and the number of the plurality of feature elements;

identifying a new set of potentially relevant images based on the re-comparing; and

presenting the new set of potentially relevant images to the user.

20. (Original) One or more computer readable media as recited in claim 19, wherein the re-comparing comprises dynamically selecting the type of matrix to use based on both a number of the potentially relevant images for which user feedback has been received and the number of the plurality of feature elements.

21. (Original) One or more computer readable media as recited in claim 19, wherein the dynamically weighting comprises using a first type of matrix if the number of retrieved relevant images is less than the length of the feature vector, and otherwise using a second type of matrix.

22. (Original) One or more computer readable media as recited in 21, wherein the first type of matrix comprises a diagonal matrix and the second type of matrix comprises a full matrix.

23. (Original) A method comprising:  
generating a query vector corresponding to a feature of one image;  
identifying a feature vector corresponding to the feature of another image;  
identifying a number of training samples for which relevance feedback has been received;

if the number of training samples either equals or exceeds a threshold amount, then determining a distance between the query vector and the feature vector including transforming the query vector and the feature vector to a higher-level feature space and then assigning a weight to each element of the transformed query vector and the transformed feature vector; and

if the number of training samples does not exceed the threshold amount, then determining the distance between the query vector and the feature vector including assigning a weight to each element of the query vector and the feature vector.

24. (Original) A method as recited in claim 23, wherein the feature vector includes a plurality of feature elements and wherein the threshold amount comprises the number of feature elements in the feature vector.

25. (Original) A method as recited in claim 23, wherein if the number of training samples either equals or exceeds the threshold amount, then determining the distance ( $g$ ), where  $P$  is a mapping matrix,  $\vec{q}$  is the query vector,  $\vec{x}$  is the feature vector, and  $\Lambda$  is a weighting matrix, as:

$$g = (P(\vec{q} - \vec{x}))^T \Lambda (P(\vec{q} - \vec{x})).$$

26. (Original) A method as recited in claim 23, wherein if the number of training samples does not exceed the threshold amount, then determining the distance ( $g$ ), where  $\vec{q}$  is the query vector,  $\vec{x}$  is the feature vector, and  $\Lambda$  is a weighting matrix, as:

$$g = (\vec{q} - \vec{x})^T \Lambda (\vec{q} - \vec{x}).$$

27. (Previously presented) A method as recited in claim 23, further comprising:

repeating the generating, identifying of the feature vector, identifying of the number of training samples, and the determining for each of a plurality of features;  
and

identifying how closely the image and the another image match each other by combining the distances between the query vectors and the feature vectors for the plurality of features.

28. (Previously presented) A method as recited in claim 27, wherein the identifying how closely the image and the another image match each other comprises calculating a weighted summation of each of the individual distances for each of the plurality of features.

29. (Original) One or more computer readable media including a computer program that is executable by a processor to perform the method recited in claim 23.

30. (Original) A system comprising:

a query vector generator to generate a query vector corresponding to a feature of one image;

a comparator, coupled to the query vector generator, to,

identify a feature vector corresponding to the feature of another image,

identify a number of training samples for which relevance feedback has been received,

if the number of training samples either equals or exceeds a threshold amount, then to determine a distance between the query vector and the feature vector including transforming the query vector and the feature vector to a higher-level feature space and then assigning a weight to each element of the transformed query vector and the transformed feature vector, and

if the number of training samples does not exceed the threshold amount, then to determine the distance between the query vector and the feature vector including assigning a weight to each element of the query vector and the feature vector.

31. (Cancelled).

32. (Previously presented) A method comprising:  
for one of a plurality of images and each of a plurality of features,  
generating, based on a set of search criteria, a query vector for the feature,  
identifying a feature vector, corresponding to the image, for the feature, and  
determining how closely the feature vector matches the query vector; and  
determining how closely the image matches the set of search criteria based  
on how closely, for the plurality of features, the feature vectors match the query  
vectors, wherein generating the query vector comprises generating the query  
vector based at least in part on user relevance feedback regarding how relevant  
images previously displayed to a user were.

33. (Currently amended) A method ~~as recited in claim 32, comprising:~~  
for one of a plurality of images and each of a plurality of features,  
generating, based on a set of search criteria, a query vector for the feature,  
identifying a feature vector, corresponding to the image, for the feature,  
wherein identifying the feature vector ~~comprises~~ includes:  
    identifying a low-level feature vector corresponding to the feature;  
and  
    mapping the low-level feature vector to a higher level feature space;  
determining how closely the feature vector matches the query vector; and  
determining how closely the image matches the set of search criteria based  
on how closely, for the plurality of features, the feature vectors match the query  
vectors, wherein generating the query vector comprises generating the query

vector based at least in part on user relevance feedback regarding how relevant images previously displayed to a user were.

34. (Original) A method as recited in claim 33, wherein the identifying the feature vector further comprises incorporating, into the mapping, relevance feedback.

Claims 35-45 (Cancelled).

46. (Original) A method of generating a query vector to compare to a feature vector of another image, the method comprising:

receiving feedback regarding the relevance of each image of a set of images;

wherein  $N$  represents the number of images in the set of images for which user relevance feedback has been received,  $\pi_n$  represents the relevance of image  $n$  in the set of images,  $\pi^{\rightarrow T}$  represents a transposition of a vector generated by concatenating the individual  $\pi_n$  values, and  $X$  represents an image matrix that is generated by stacking  $N$  training vectors corresponding to the set of images into a matrix; and

generating a query vector ( $\vec{q}$ ) corresponding to one of a plurality of features as follows:

$$\vec{q} = \frac{\pi^{\rightarrow T} X}{\sum_{n=1}^N \pi_n}.$$

47. (Original) One or more computer readable media including a computer program that is executable by a processor to perform the method recited in claim 46.

48. (Original) A method of generating a weight to apply to distances between query vectors and feature vectors when combining the distances, the method comprising:

receiving feedback regarding the relevance of each image of a set of images;

wherein  $f_i$  represents a summation, over the images in the set of images, of a product of a relevance of the image and a distance between the query vector and the feature vector; and

generating a weight ( $u_i$ ) for each of a plurality ( $I$ ) of distances between a query vector corresponding to one of a plurality ( $I$ ) of features and a feature vector corresponding to the one of the plurality ( $I$ ) of features as:

$$u_i = \sum_{j=1}^I \sqrt{\frac{f_j}{f_i}}.$$

49. (Original) One or more computer readable media including a computer program that is executable by a processor to perform the method recited in claim 48.

50. (Cancelled).

51. (Cancelled).

52. (Currently amended) One or more computer readable media ~~as recited in claim 1~~ having stored thereon a plurality of instructions that, when executed by one or more processors, causes the one or more processors to perform acts including:

receiving an initial image selection;

generating a plurality of query vectors by extracting, for each query vector, one of a plurality of low-level features from the initial image selection;

selecting a set of potentially relevant images based at least in part on distances between the plurality of query vectors and a plurality of feature vectors corresponding to low-level features of a plurality of images;

receiving feedback regarding the relevance of one or more images of the set of potentially relevant images, wherein the receiving feedback comprises includes receiving feedback via speech recognition; and

generating a new plurality of query vectors based at least in part on the feedback.

53. (Original) One or more computer readable media as recited in claim 19, wherein the receiving user feedback regarding relevancy comprises receiving user feedback in a range including at least Highly Relevant, Relevant, No Opinion, Irrelevant, and Highly Irrelevant.

54. (Original) One or more computer readable media as recited in claim 19, wherein the receiving user feedback comprises receiving user feedback via speech recognition.



55. (Previously presented) One or more computer readable media including a computer program that is executable by a processor to cause the processor to perform acts of:

receiving user feedback regarding the relevance of each image of a set of images, the user feedback forming a range including at least Highly Relevant, Relevant, No Opinion, Irrelevant, and Highly Irrelevant;

wherein  $N$  represents the number of images in the set of images for which user feedback has been received,  $\pi_n$  represents the relevance of image  $n$  in the set of images,  $\pi^{\rightarrow T}$  represents a transposition of a vector generated by concatenating the individual  $\pi_n$  values, and  $X$  represents an image matrix that is generated by stacking  $N$  training vectors corresponding to the set of images into a matrix; and generating a query vector ( $\vec{q}$ ) corresponding to one of a plurality of features as follows:

$$\vec{q} = \frac{\pi^{\rightarrow T} X}{\sum_{n=1}^N \pi_n}.$$

56. (Original) One or more computer readable media as recited in claim 55, wherein the receiving user feedback comprises receiving user feedback via speech recognition.

57. (Previously presented) One or more computer readable media having stored thereon a plurality of instructions that, when executed by one or more processors, causes the one or more processors to:

select a set of potentially relevant images based at least in part on distances between a plurality of query vectors extracted from an initial image selection and a plurality of feature vectors corresponding to low-level features of a plurality of images;

receive feedback regarding the relevance of one or more images of the set of potentially relevant images;

generate a new plurality of query vectors based at least in part on the feedback;

generate a weighting of feature elements based at least in part on the feedback; and

select a new set of potentially relevant images based at least in part on both the weighting of feature elements and distances between the new plurality of query vectors and the plurality of feature vectors, wherein  $f_i$  represents a summation, over the images in the set of potentially relevant images, of a product of a relevance of the image and a distance between the query vector and the feature vector, and wherein the selecting a new set of potentially relevant images comprises combining, for each image, a weighted distance between the plurality of query vectors and the plurality of feature vectors, and wherein the weight ( $u_i$ ) for each of a plurality ( $I$ ) of distances between a query vector and a corresponding feature vector is calculated as:

$$u_i = \sum_{j=1}^I \sqrt{\frac{f_j}{f_i}}.$$

58. (Previously presented) One or more computer readable media as recited in claim 57, wherein the plurality of instructions to cause the one or more processors to select comprises instructions to cause the one or more processors to use a matrix in determining the distance between one of the new plurality of query vectors and one of the plurality of feature vectors, and further comprises instructions to cause the one or more processors to dynamically select the matrix based on both a number of images in the set of potentially relevant images for which relevance feedback was input and a number of feature elements in the one feature vector, wherein the instructions to dynamically select comprise instructions to cause the one or more processors to use a diagonal matrix when the number of images in the set of potentially relevant images for which relevance feedback was input is less than a number of feature elements in the one feature vector, and otherwise using a full matrix.

59. (Previously presented) One or more computer readable media as recited in claim 57, wherein the plurality of instructions to cause the one or more processors to select comprises instructions to cause the one or more processors to:

use one matrix that transforms the query vector and the one feature vector to a higher-level feature space and then using another matrix that assigns a weight to each element of the transformed query vector and the transformed feature vector when the number of images in the set of potentially relevant images for which relevance feedback was input is not less than the number of feature elements in the one feature vector; and

use a matrix that assigns a weight to each element of the query vector and the one feature vector when the number of images in the set of potentially relevant images is less than the number of feature elements in the one feature vector.

60. (Previously presented) One or more computer readable media including computer readable instructions executable by one or more processors to cause the one or more processors to select between two types of matrixes to be used to weight, based on relevance feedback, a plurality of feature elements for image retrieval, wherein the instructions are further executable to cause the one or more processors to select one of the two types of matrixes based on both a number of previously retrieved relevant images and a length of a feature vector including the plurality of feature elements.

61. (Previously presented) One or more computer readable media as recited in claim 60, wherein instructions executable to cause the one or more processors to select comprise instructions executable to cause the one or more processors to select one of the two types of matrixes based on both a number of previously retrieved potentially relevant images which were identified by a user as being relevant, and the length of the feature vector including the plurality of feature elements.

62. (Previously presented) One or more computer readable media as recited in claim 60, wherein the plurality of feature elements are all elements of the same feature.

63. (Previously presented) One or more computer readable media as recited in claim 60, wherein instructions executable to cause the one or more processors to select comprise instructions executable to cause the one or more processors to use a first type of matrix when the number of retrieved relevant images is less than the length of the feature vector, and otherwise use a full matrix.

64. (Previously presented) One or more computer readable media as recited in claim 60, wherein instructions executable to cause the one or more processors to select comprise instructions executable to cause the one or more processors to use a diagonal matrix when the number of retrieved relevant images is less than the length of the feature vector, and otherwise use another type of matrix.

65. (Previously presented) One or more computer readable media as recited in claim 60, wherein instructions executable to cause the one or more processors to select comprise instructions executable to cause the one or more processors to use a full matrix when the length of the feature vector exceeds the number of retrieved relevant images by at least a threshold amount, and otherwise use another type of matrix.

66. (Previously presented) One or more computer readable media as recited in claim 60, wherein instructions executable to cause the one or more processors to select comprise instructions executable to cause the one or more

processors to use a full matrix when the length of the feature vector exceeds the number of retrieved relevant images by at least a threshold amount, and otherwise use a diagonal matrix.